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# Contribution to the knowledge of the genus *Zygaena* Fabricius, 1775, in Iran (Lepidoptera, Zygaenidae). Part X: On two newly discovered *Mesembrynus* taxa from the western Alborz

Axel Hofmann[1], Alireza Naderi[2]

1 *Corresponding author. Am Hochgestade 5, 76351 Linkenheim-Hochstetten, Germany. hofmann@abl-freiburg.de*

2 *Entomolgy Section, Natural History Museum & Genetic Resources, Department of Environment of Iran, Pardisan Park, Hemat Avenue, Tehran, Iran. a2naderi@yahoo.com*

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**Abstract.** Two well-defined *Zygaena* taxa are described from the central Alborz range in Iran and are placed as subspecies of two known *Mesembrynus* species. Both taxa inhabit biotopes on the northern side of the main Alborz range, areas that are climatically influenced by the Caspian Sea. *Zygaena speciosa oseyii* ssp. n. is represented by the most north-westerly populations of *Z. speciosa* Reiss, 1937, from Kuh-e Samamus, Gardaneh-ye Tondrokosh and from Kuh-e Khash-Chal, all of which are characterized by the absence of melanistic forms, while the nominotypical populations exhibit only melanistic forms. *Zygaena tamara dailamica* ssp. n. differs from all known populations of *Z. tamara* by having a different red coloration while the red abdominal cingulum is restricted to one segment. Moreover, consistent differences are found in the larval phenotype although several cross-breedings (*Z. tamara tamara* Christoph, 1889 × *Z. tamara dailamica* ssp. n.) were successful.

**Zusammenfassung.** Aus dem zentralen Elbursgebirge/Iran werden zwei außergewöhnliche *Zygaena*-Taxa beschrieben und bereits bekannten *Mesembrynus*-Arten subspezifisch zugeordnet. Die Fundorte beider Taxa befinden sich nördlich des Elburs-Hauptkammes; sie sind klimatisch bereits vom Kaspischen Meer beeinflußt. Zu *Zygaena speciosa oseyii* ssp. n. ziehen wir die nordwestlichsten Populationen vom Kuh-e Samamus, vom Gardaneh-ye Tondrokosh und vom Kuh-e Khash-Chal. Diese Populationen unterscheiden sich von der Nominatform durch das Fehlen melanistischer Formen. *Zygaena tamara dailamica* ssp. n. weicht von allen bekannten *Z. tamara*-Population durch eine andere Rotfärbung so wie durch einen stets einfachen, roten Abdominalring ab. Auch im Raupenphänon bestehen konstante Unterschiede; Kreuzungsversuche (*Z. tamara tamara* Christoph, 1889 × *Z. tamara dailamica* ssp. n.) verliefen jedoch erfolgreich.

## Introduction

Currently the family Zygaenidae is subdivided into four subfamilies (Chalcosiinae, Procridinae, Callizygaeninae, Zygaeninae) of which Zygaeninae comprises two Palaearctic (*Zygaena, Pryeria* Moore, 1877), one Oriental (*Epizygaenella* Tremewan & Povolný, 1968) and six Afrotropical genera (*Reissita* Tremewan, 1959, *Epiorna* Alberti, 1954, *Orna* Kirby, 1892, *Zutulba* Kirby, 1892, *Praezygaena* Alberti, 1954, *Neurosymploca* Wallengren, 1858). The most species-rich genus *Zygaena*, with 108 currently recognised species (Hofmann and Tremewan 2010), has its recent centres of high diversity in the western Mediterranean region, Iran and Central Asia. Species of this

group are found from sea-level up to more than 4500 m in altitude. The highlands of Iran and Central Asia are especially rich in high-mountain endemics.

On June 25, 2006, A. Naderi discovered near the top of Kuh-e Samamus (3687 m) south-east of Ramsar (Iran), at an altitude of *ca.* 3350 m a new and extraordinarily distinct population of *Z. speciosa*, a high-mountain species that is endemic to Iran. Two weeks later, A. Naderi & A. Hofmann undertook fieldwork at this locality. Before reaching the village of Javaherdeh, which is located at the foot of Kuh-e Samamus, we crossed the Alborz Range via two passes between Qazvin and the Caspian plain between13.–15.7.2006, the road consisting partly of a very bad gravel road. North-east of Hir we collected near Gardaneh-ye Ambarkesh (2500 m), further north in the vicinity of Tamol and then in the vicinity of Gardaneh-ye Tondrokosh (3100 m). At all of these localities we found another taxon that could not be referred to any known species at that time. The colour reminded us of *Z. tamara*, but the abdominal cingulum was present only on one segment, a character that is consistently different in all populations of *Z. tamara*, independently of whether they are red/red, red/yellow or yellow/yellow (Naumann 1987: 210, fig. 9, Hofmann and Tremewan 2001). *Zygaena tamara* Christoph, 1889, is a widely distributed, polymorphic and polytypic burnet moth occurring in western Iran, Armenia, Azerbaijan, eastern Turkey and northern Iraq (Naumann 1987: 211, fig. 10). In the Alborz range the species is uncommon and its range obviously does not extend further east than the vicinity of Semnan. In the central Alborz no populations are recorded from the north side of the main mountain chain which is influenced by the Caspian climate. Based on its recent distribution, Naumann (1987: 207) characterised *Z. tamara* as an Irano-eremic faunal element.

## Methods

More general introductions of the topic for a whole series of papers can be found in Hofmann (2000a) and Hofmann and Kia-Hofmann (2008). The results recorded in the present paper are based on fieldwork in Iran, successfully reared ab-ovo cultures (in Germany; Hofmann and Kia-Hofmann 2008, 2011) and genitalia dissections. Using the standard method of preparation (Robinson 1976), the genitalia were examined, embedded in Euparal on permanent microscopic slides and photographed with a digital stereo-microscope (G. Tarmann, Innsbruck, Austria). Dissected specimens with slides are deposited in CAHO. The terminology of the genitalia structures follows that of Alberti (1958: 263–268); for the terminology of the forewing pattern see Alberti (1958: 258), Tremewan (1985: 102) and Hofmann (2003: 53).

### Abbreviations

| | |
|---|---|
| CAHO | Collection Axel Hofmann, Linkenheim-Hochstetten, Germany. |
| CWGT | Collection W. Gerald Tremewan, Truro, Great Britain. |
| CV | used for chronological reference of cultures in captivity; it means "Copula-Versuch" or beginning of 'curriculum vitae', e.g. CV070604 began with a copula on 4 June 2007. |
| HMIM | Hayk Mirzayans Insect Museum, Tehran, Iran. |
| SMNK | Staatliches Museum für Naturkunde Karlsruhe, Germany. |

**Table 1.** List of localities in Iran.

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|---|---|---|---|---|
| *Zygaena speciosa oseyii* ssp. n. | Prov. Gilan, Kuh-e Samamus, Javaherdeh 20 km SSW. | 3350 – 3400 m | 36°50.92′N | 50°23.66′E |
| *Zygaena speciosa oseyii* ssp. n. | Prov. Mazandaran, Tonekabon SW., Gardaneh-ye Tondrokosh (Zarout) | 3270– 3350 m | 36°41.76′N | 50°29.77′E |
| *Zygaena speciosa oseyii* ssp. n. | Prov. Qazvin NE., Mo'allem Kalayeh, vic., Kuh-e Khash-Chal | 3390–3430 m | 36°32.53′N | 50°30.31′E |
| *Zygaena tamara dailamica* ssp. n. | Prov. Qazvin, Hir NE., Gardaneh-ye Anbarkesh, N. side | 2780–2900 m | 36°37.46′N | 50°21.34′E |
| *Zygaena tamara dailamica* ssp. n. | Prov. Mazandaran, Tonekabon SW., Tamol vic. | 2250–2400 m | 36°38.87′N | 50°25.71′E |
| *Zygaena tamara dailamica* ssp. n. | Prov. Mazandaran, Tonekabon SW., Gardaneh-ye Tondrokosh (Zarout) N. | 2800–3000 m | 36°41.35′N | 50°31.96′E |

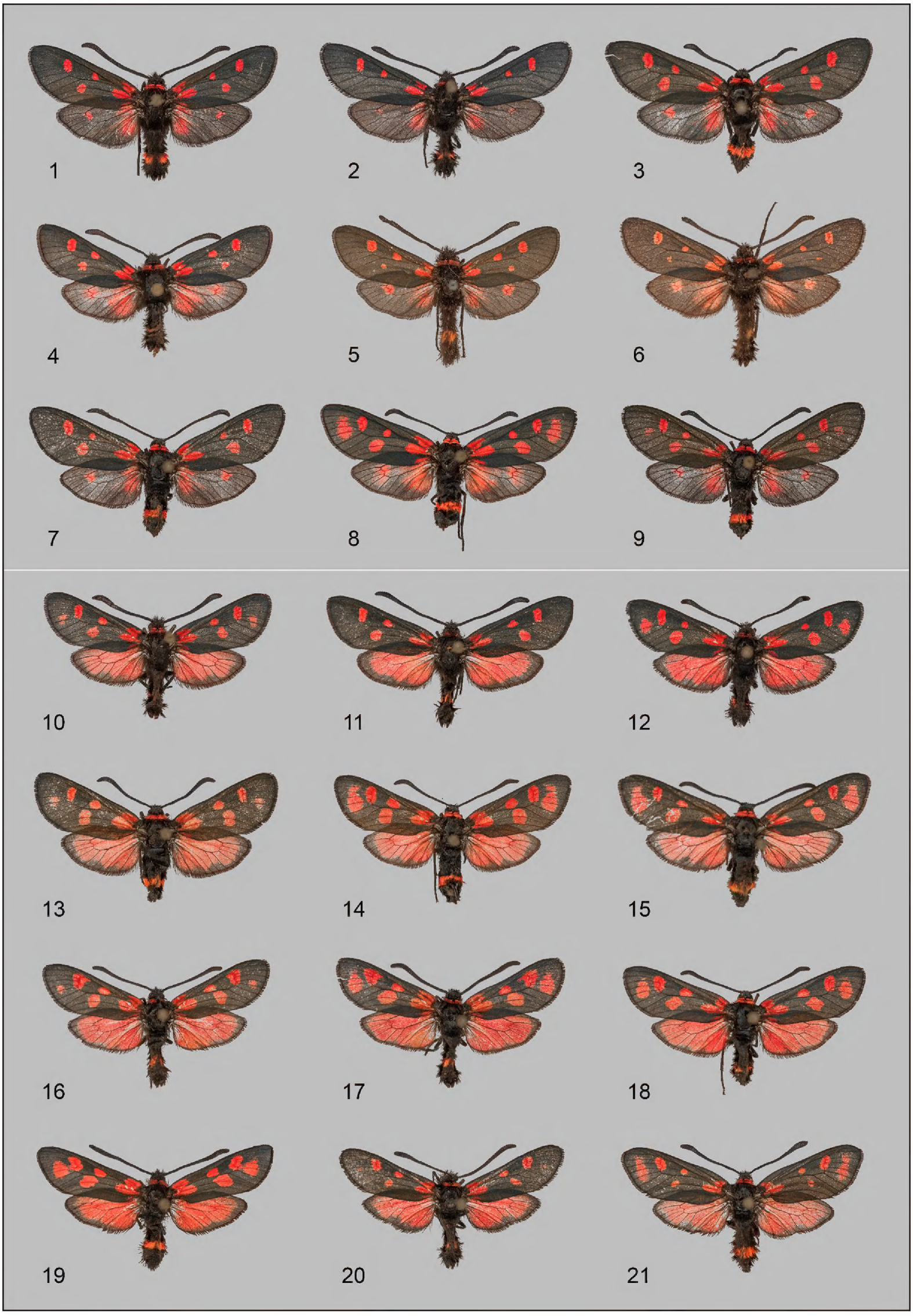
## The high-mountain *Mesembrynus*-species of the Alborz Range (Iran)

Traditionally the genus *Zygaena* comprises three subgenera, *Agrumenia* Hübner, [1819], *Zygaena,* and *Mesembrynus* Hübner, [1819], but only the last subgenus appears to be a well-defined monophylum based on molecular data (Niehuis et al. 2007). In contrast to the other two paraphyletic subgenera, the larvae of *Mesembrynus* live on acyanogenic plants, mainly Apiaceae (only a few species secondarily switched to Lamiaceae and Asteraceae).

Naumann (2000) and Hofmann (2000) have provided detailed information on the rediscovery (the latter author also on the biology) of *Zygaena cacuminum* Christoph, 1877, in the Shah-Kuh region, while Hofmann and Kia-Hofmann (2008) have described the bionomics and distribution of *Z. speciosa* Reiss, 1937, both of these taxa being closely related, endemic Iranian species that are restricted to the oreal biome of the Alborz Range where *Z. cacuminum* inhabits cushion zone biotopes in the eastern Alborz, while *Z. speciosa* has been recorded only from the central part. As each species was known only from a single locality before 2001 (Hofmann and Kia-Hofmann 2008: 35), both were regarded at that time as unilocal and monotypic. However, Hofmann and Kia-Hofmann (2008) recorded new locality data and were able to show that neither of these species is restricted to a single site.

*Zygaena speciosa* and *Z. cacuminum* are geographically well separated, a wide gap of *ca.* 250 km existing between Shah-Kuh and the Kuh-e Damavand. Phenotypically, *Z. cacuminum* is distinguished by having on the forewings a quadrangular spot 4, a well-developed spot 6 and especially by the lack of melanistic tendencies on the hindwings. Hitherto, both high-mountain species were considered to be monotypic and represented only by populations consisting of very similar phenotypes.

On several expeditions to the central and western Alborz in 2006 and 2010 the authors had the opportunity to accrue new data on the *tamara*-like populations and also on *Z. speciosa*; those on the latter were partly incorporated in an earlier publication (Hofmann and Kia-Hofmann 2008). Of great taxonomic and zoogeographical interest are these most westerly populations, as they show that *Z. speciosa* actually is a polytypic species with a second subrange which is inhabited by purely non-melanistic populations.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### *Zygaena speciosa* Reiss, 1937

Figs 1–39

**Remarks.** Described from the Alam-Kuh region, the melanistic form (*Z. speciosa speciosa*) is currently known from seven localities between Kuh-e Demavand in the east and Alam Kuh in the west, while non-melanistic populations were unknown until now and are here recorded for the first time from three localities located between Mo'allem Kalayeh (Qazvin NE.) and Kuh-e Samamus.

### *Zygaena speciosa oseyii* ssp. n.

Figs 10–29, 33–35, 38, 39

**Material.** Holotype ♂, 28 mm wingspan, "Iran, Prov. Gilan, Kuh-e Samamus, Javaherdeh 20 km SSW, 3350–3400 m, 30.6.2006, leg. A. Hofmann & A. Naderi", [36°50,92' N, 50°23,66'E], coll. A. Hofmann (to be deposited in SMNK). Paratypes: 1 ♂, 2 ♀, same data as holotype, coll. A. Hofmann; same locality as holotype: 35 ♂, 18 ♀, 15.vii. 2006, leg. et coll. A. Hofmann; 1 ♂, coll. J. Mooser; 1 ♂, coll. A. Floriani; 7 ♂, 3 ♀, coll. T. Keil; 4 ♂, 1 ♀, leg. larvae, e.p.: 30.vi.–10.vii.2006 leg. et cult. A. Hofmann, coll. A. Hofmann; 3 ♂, 2 ♀, 25.vi. 2006, leg. A. Naderi, coll. A. Hofmann; 8 ♂, leg. et coll. A. Naderi; 16 ♂, 3 ♀, 3.viii.2007, leg. et coll. A. Naderi; 3 ♂, 1 ♀, coll. A. Hofmann; 7 ♂, 1 ♀, coll. T. Keil; 4 ♂, coll. P. Zehzad (to be deposited in HMIM). Other material: Iran, Prov. Mazandaran, Tonekabon SW, Gardaneh-ye Tondrokosh (Zarout), 3270–3350 m, [36°41,76'N, 50°29,77'E], 17 ♂, 2 ♀, 14.vii.2006, leg. A. Hofmann & A. Naderi, coll. A. Hofmann; 3 ♂, ibidem, coll. T. Keil; 2 ♂, ibidem, 10.vii.2007, leg. A. Naderi, coll. T. Keil; 5 ♂, 2 ♀, ibidem, 13. u. 14.vii.2010, leg. et coll. A. Hofmann; this locality is about 20 km southeast of Kuh-e Samamus. Iran, Prov. Qazvin NE, Mo'allem Kalayeh vic., Kuh-e Khash-Chal, 3390–3430 m, [36°32,53'N, 50°30,31'E], 11 ♂, 1 ♀, 15.vii.2010, leg. et coll. A. Hofmann; 11 ♂, 10 ♀, ibidem, 3550–3700 m, leg. et coll. A. Hofmann; this locality is about 35 km southeast of Kuh-e Samamus.

**Figs 1–21.** ***Zygaena speciosa speciosa*** **Reiss, 1937**. **1, 2.** ♂, "Iran, Prov. Tehran, | Fasham NE, Gardaneh | Yonza S, 3200–3750| m, 19.7.2010, [41/10] | leg. A. Hofmann". **3.** ♀, same data. **4.** ♂, "N. IRAN, Alborz Mts Prov. Mazandaran | Alam Koh, Hezar-chal | 36°21'N 50°59'E | 3700 m | 28 vii 1997 | leg. Naumann, Nr. 2376". **5.** ♂, red label, "Cotype ♂, *suleimanicola* Reiß 1937 [handwritten], H. Reiss", white label, "Persia sept. | Elburs mts.c.s. | Tacht i Suleiman | Särdab Tal | (Hećerćam) | 4200 m 20.7.37 | E. Pfeiffer & W.Forster | München leg.". **6.** ♂, red label, "Cotype ♂, *speciosa* Reiß 1936 [handwritten], H. Reiss", white label, "Persia s. | Elburs mts.s. | Tacht i Suleiman | Hecarčal-Tal | 28–3200m 3-7.VII 36 | E. Pfeiffer- München leg.", white label, "2.2.1955 | von Güner | zum 40. Geb. | coll. A. Hofmann". **7.** ♀, "IRAN, Tehran | Tehran N, Kuh-e Tochal | S-Seite, 3600–3800 m | 3. u. 4.8.2005, [68/05] | T. & A. Hofmann leg. | ♀ legt Eier [handwritten]". **8.** ♀, "IRAN, Tehran | Tehran N, Kuh-e Tochal |3600–3800 m | 28.6.2006, [15/06] | T. & A. Hofmann leg. larva | e.p. : 12.7.2006". **9.** ♀, "IRAN, Tehran | Tehran N, Kuh-e Tochal | S-Seite, 3600–3800 m | 4.8.2006, [45/06] | A. Hofmann leg.". **10–21.** ***Zygaena speciosa oseyii*** ssp. n., **10.** Holotype, ♂, (CAHO). **11, 12.** Paratypes, ♂, " Iran, Prov. Gilan | Kuh-e Samamus, Javaherdeh | 20 km SSW, 335 –3400 m |15.7.2006, [31/06] | A. Hofmann leg.". **13–15.** Paratypes, ♀, same data. **16, 17.** ♂, " Iran, Prov. | Mazandaran, Toneka- | bon SW, Gardaneh-ye | Tondrokosh (Zarout), | 3270–3350 m, 13.– | 14.7.2010, [38/10] | leg. A. Hofmann". **18.** ♀, "IRAN, Mazandaran | Tonekabon SW, Gardaneh-ye | Tondrokosh (Zarout), 3270– | 3350 m, 14.7. 2006, [29/06] | A. Hofmann & A. Naderi leg.". **19.** ♂, " Iran, Prov. Qazvin | NE, Mo'allem Kalayeh | vic., Kuh-e Khash-Chal | 3390–3430 m | 15.7.2010, [39/10] | leg. A. Hofmann". **20.** ♂, same data, but 3550–3700 m. **21.** ♀, same data. All specimen CAHO.

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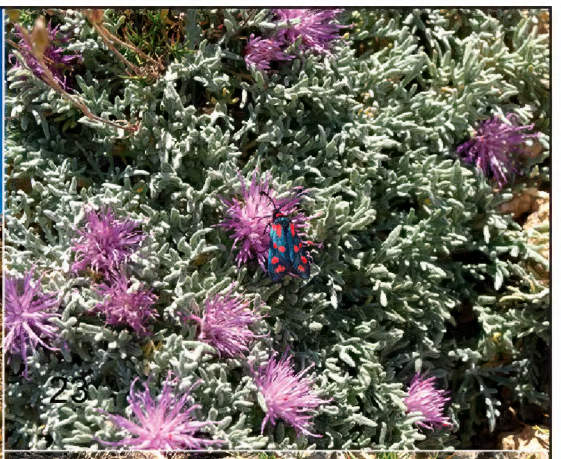
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**Etymology.** Dedicated to Abbas Oseyi (Karaj), who accompanied the second author when discovering the first population at Kuh-e Samamus.

**Description.** A group of strictly non-melanistic populations. Black ground colour of forewings with greenish sheen, more greyish and more translucent in females. Hindwings with black border of medium width, stronger at apex and with a double-tooth in the beginning of anal field at the tornus, but never invading the discal area. Forewing spots 1+2, 3+4 and 5 well developed and always present, spots 1+2+2a forming the basal blotch, with spot 2 elongate, longer than spot 1, while spot 2a is vestigial. Spot 3 small, ovoid, spot 4 larger, quadrangular; both spots always separated by the cubitus stem vein. Spot 5 of similar size and form as spot 4, but standing more vertically, isolated from spot 6. The latter (spot 6) more variable: it can be absent in both sexes (20%), but more frequently in the males, it can be vestigial and reduced to a few scales (25%), or well developed as a normal spot in the costal part (25%), or reniform, the upper part then smaller (30%). Red patagia and red abdominal cingulum present on one segment, well developed in females, reduced or vestigial in males. The abdominal cingulum can even be absent or reduced to only a few red lateral scales (20%).

**Remarks.** Specimens from two other populations that are not from the type-locality are well separated geographically and differ slightly from the type-series; while they can be assigned to *oseyii* subsp. n., they are not included in the type-series.

**Diagnosis.** In specimens from Gardaneh-ye Tondrokosh (Figs 13–18), spot 6 is always present and larger, the black ground colour of the males is more bluish and the hindwing border is narrower with a very weak expansion at the apex. In specimens from Kuh-e Khash-Chal (Figs 19–21), spots 5 and 6 are mostly closer together and occasionally they are even connected to each other. Otherwise both populations look similar to *Z. speciosa oseyii* ssp. n. from the type-locality (Figs 10–12). The difference between *oseyii* ssp. n. (Figs 10–21) and the nominotypical subspecies from the type-locality in the Alam-Kuh region (Figs 4–6) is extraordinarily strong. In contrast to the nominotypical population from Hezarchal (and from those from Dizin-Shemshak and from Kuh-e Tochal), the more north-westerly located populations (Figs 10–21) from between Kuh-e Khash-Chal and Kuh-e Samamus do not exhibit a tendency for melanism. The hindwings are red with a variable broad border and are never darkened, while the border never forms a "tooth" along the

**Figs 22–29. *Zygaena speciosa oseyii* ssp. n., habitats, bionomics**. **22.** Bolder scree habitat (foreground) near Gardaneh-ye Tondrokosh with view to type-locality (arrow) at Kuh-e Samamus around 20 km as the crow flies north-west. Note the clouds coming up from the Caspian Sea and reaching the northern slopes of the higher Alborz Mountain Chains. **23.** Female moth nectaring on high-mountain composite *Jurinella frigida* (Boiss.) Wagenitz (Compositae) (Gardaneh-ye Tondrokosh, 14.VII.2010). **24.** On *Thymus* sp. (Lamiaceae) (Gardaneh-ye Tondrokosh, 14.VII.2010). **25.** *Valeriana sisymbrifolia* Kabath (Valerianaceae) was the only nectar plant noted at Kuh-e Khash-Chal, 3390–3700 m, 15.VII.2010. **26.** Cushion zone at Gardaneh-ye Tondrokosh, habitat of *Z. speciosa* and a high-mountain population of *Z. carniolica*. **27.** Foggy weather conditions during the flight period of *Z. speciosa oseyii* ssp. n. at its most eastern habitat at Kuh-e Khash-Chal, 3390–3700 m, 15.VII.2010. **28.** Ovipositing female (arrow) on larval host-plant (*Semenovia tragioides* (Boiss.) Manden, Apiaceae) at Kuh-e Khash-Chal, 3390–3700 m, 15.VII.2010. **29.** Cocoon with exuviae on the underside of limestone beside the flowering host-plant (*S. tragioides*), Gardaneh-ye Tondrokosh, 14.VII.2010).

**Figs 30–39. Diagnostic characters of male genitalia** of *Zygaena speciosa speciosa* (30–32, 36, 37) and *Z. speciosa oseyii* ssp. n. (33–35, 38, 39). **30, 33.** Uncus-tegumen complex. **31, 34.** Lamina dorsalis. **32, 35.** Lamina ventralis. **36, 38.** Valva with vinculum and saccus. **37, 39.** Phallus (Aedoeagus sensu Alberti, 1958) with cornuti.

anal vein. Spot 6 is either strongly reduced or predominantly completely missing in *Z. speciosa speciosa*, while it is predominantly present or at least vestigial in *Z. speciosa oseyii* ssp. n. Not a single specimen from all of these three new localities can be confused with specimens from Alam Kuh, Dizin-Shemshak or from Kuh-e Tochal, nor can any single specimen from these localities be incorporated into the series of *oseyii* ssp. n. The localities of the most easterly population of *oseyii* ssp. n. (Kuh-e Khash-Chal) and *Z. speciosa speciosa* are less than 40 km from each other as the crow flies and, surprisingly, the population nearest to the Alam-Kuh population even exhibits the most reddish forms of all three known populations.

**Genitalia.** Differences in genitalia structures within species-groups of *Zygaena* (Hofmann and Tremewan 2010) are often poor, especially in the *manlia*-group, and significant characters for separating closely related taxa are obviously lacking (Hofmann and Keil 2011: 244–245), which is why fertile hybrid-crossings in captivity were relatively easily to obtain (Hofmann 2000b, Hofmann and Kia-Hofmann 2010).

We found slight differences in the uncus and lamina dorsalis of the male genitalia between *Z. speciosa speciosa* (Figs 30-32, 36, 37) and *Z. speciosa oseyii* ssp. n. (Figs 33–35, 38, 39), but we do not interpret them as prezygotic mechanisms of isolation. The uncus of the nominotypical subspecies is more cone-shaped, attenuated at the end (compare Figs 30 and 33), while the lamina dorsalis is broadest at the middle part and becomes narrower toward the base (compare Figs 31 and 34), in contrast to *Z. speciosa oseyii* ssp. n. in which this structure is more pyramidal-like, broadest at its base. However, there may be variation in these structures and even if dissections of a series would confirm these as constant characters, they would nevertheless not prevent successful pairings, but may reflect strict isolation with diverse developments in the post-glacial period. Furthermore, if one takes the 100% separation in phenotype into account, a clear tendency for species-specific differentiation on the way to distinct biospecies becomes obvious.

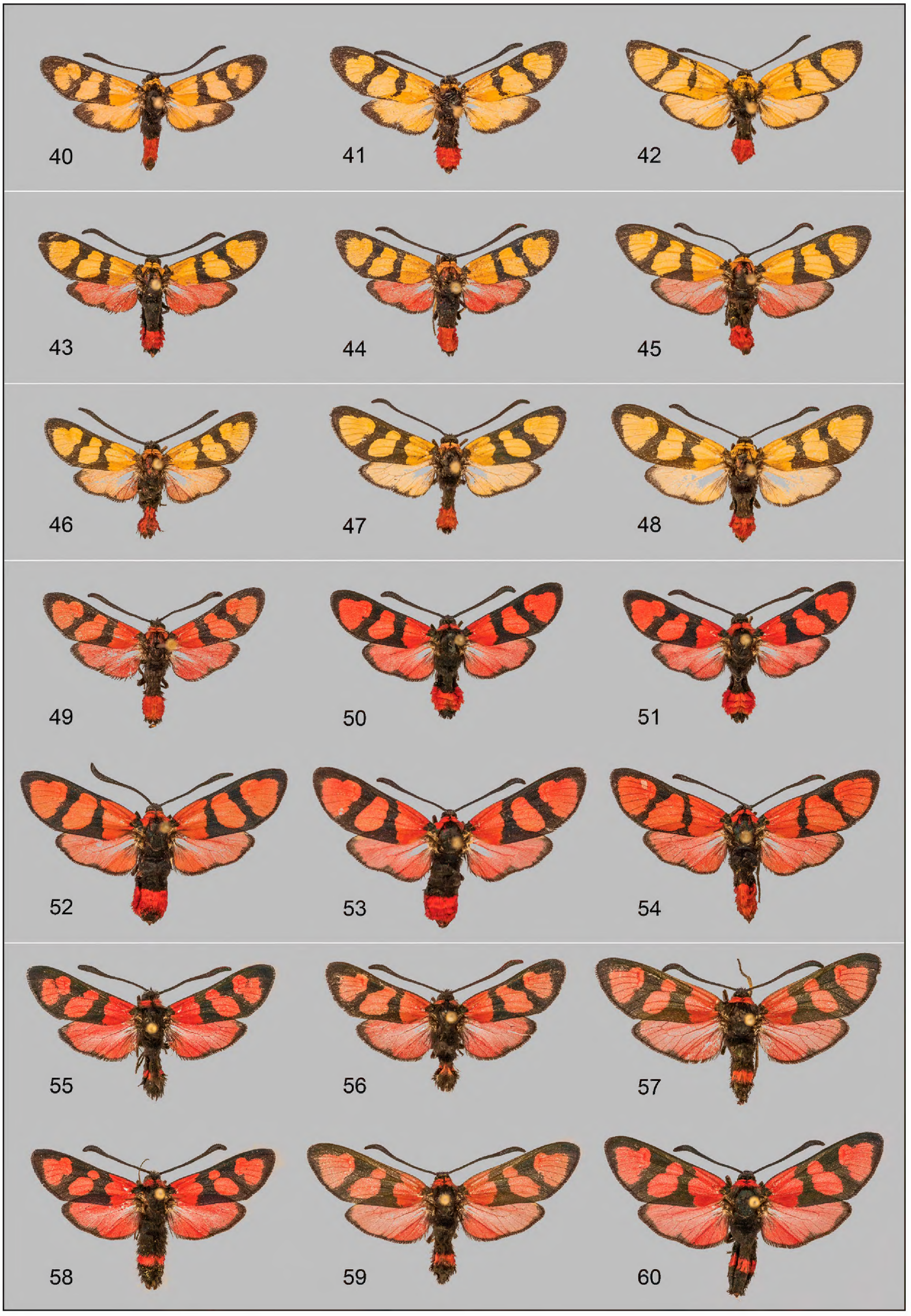
**Bionomics.** Detailed data on the bionomics with figures of larvae, host-plants and biotopes, together with a distribution map that includes the populations of *Z. speciosa oseyii* ssp. n., have been provided by Hofmann and Kia-Hofmann (2008: 25–49). At all three localities, *Z. speciosa oseyii* ssp. n. is syntopic with *Z. carniolica*.

**Distribution.** In addition to the type-locality, *Z. speciosa oseyii* ssp. n. is known from two further sites, both of which are located further east of the Kuh-e Samamus (Fig. 22). All three sites are situated at altitudes between 3270 and 3700 m. A gap of *ca.* 40 km between ssp. *oseyii* and ssp. *speciosa* remains unexplored. Further prospecting, especially in the Kuh-e Sialan region, will show that either there is a transitional zone with mixed populations or a sharp divide between the melanistic and 'normal' forms.

### *Zygaena tamara* Christoph, 1889

Figs 40–72

**Remarks.** The pure red populations of the Kendevan region have been described as ssp. *kendevanica* Tremewan, 1977, and populations with the same phenotype are found further south-west to Zanjan (Figs 49–54). Similar pure red populations occur in the Van Gölü region in eastern Turkey (ssp. *placida* Bang-Haas, 1913), while the Zagros range, the Iranian Talysh and Azerbaijan-e Sharqi are predominantly inhabited by populations with mixed characters of yellow forewings and red hindwings (Figs 43–45) or yellow fore- and hindwings (Figs 40–42, 46–48). A unique character that distinguishes all of these populations of *Z. tamara* from all other *Mesembrynus* species is the red abdominal cingulum that is present on two to three segments in the females and on three segments in the males (Figs 40–54, 63), a character that is in strong contrast to the newly discovered populations from the northern side of the Alborz range, which we here describe as *Zygaena tamara dailamica* ssp. n.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## *Zygaena tamara dailamica* ssp. n.

Figs 55–63, 64–70, 72

**Material.** Holotype ♂, 31 mm wingspan, "Iran, Prov. Qazvin, Hir NE, Gardaneh-ye Anbarkesh, N-Seite, 2780–2900 m, 13.7.2006, leg. A. Hofmann & A. Naderi", [36°37,46'N, 50°21,34E], coll. A. Hofmann (to be deposited later in SMNK). Paratypes, same data as holotype: 7 ♂, 4 ♀, coll. A. Hofmann; 2 ♂, coll. T. Keil; 3 ♂, 1 ♀, leg. et coll. A. Naderi. Same locality as holotype: 3 ♂, 18.vii.2007, leg. T. & C. Keil, coll. T. Keil. Same locality as holotype, F1, ab ovo, coll. A. Hofmann: 13 ♂, 15 ♀, e. p.: 26.iv.–29.v.2007; 19 ♂, 21 ♀, e. p.: 22.iv.–15.vii.2008; 4 ♂, 2 ♀, e. p.: 27.v.–11.vi.2009. Ibidem, F2: 3 ♂, 7 ♀ (ex CV070523), e. p.: 3.v.–23.vi.2008; 2 ♂, 3 ♀ (ex CV070523), e. p.: 3.–14.vi.2009; 1 ♂, 1 ♀ (ex CV08053,2), e. p.: 27.–30.v.2009. Ibidem, F3: 2 ♂, 3 ♀ (ex CV080503,1), e. p.: 29.v.–28.vi.2009. 10 ♂, 8 ♀, "Iran, Prov. Mazandaran, Tonekabon SW, Tamol vic., 2250–2400 m, 14.vii.2006, leg. A. Hofmann & A. Naderi", [36°38,87'N, 50°25,71'E], coll. A. Hofmann; 2 ♂, coll. T. Keil; 3 ♂, 1 ♀, leg. et coll. A. Naderi; 24 ♂, 6 ♀, 18.vii.2007, leg. T. & C. Keil, coll. T. Keil; 3 ♂, leg. et coll. A. Naderi; 4 ♂, 4 ♀, 13.vii.2010, leg. et coll. A. Hofmann. Ibidem, F1, ab ovo, coll. A. Hofmann: 15 ♂, 28 ♀, e. p.: 22.v.–30.v.2007; 2 ♂, 3 ♀, e. p.: 15.–24.v.2008; 8 ♂, 9 ♀, F2 (ex CV070522,2), e. p.: 30.iv.–15.vii.2008. Ibidem, F2: 2 ♂, 6 ♀ (ex CV070522,2), e. p.: 2.–19.vi.2009; 3 ♂, 4 ♀ (ex CV070524), e. p.: 4.v.–11.v.2008; 6 ♂, 5 ♀ (ex CV070524), e. p.: 1.–11.vi.2009. 2 ♀, "Iran, Prov. Mazandaran, Tonekabon SW, Gardaneh-ye Tondrokosh (Zarout) N, 2800–3000 m, 14.vii.2006, leg. A. Hofmann & A. Naderi", [36°41,35'N, 50°31,96'E], coll. A. Hofmann; 3 ♂, coll. T. Keil; 5 ♂, 2 ♀, leg. et coll. A. Naderi; 1 ♂, coll. P. Zehzad; 3 ♀, 14.vii.2010, leg. et. coll. A. Hofmann. Paratypes will be deposited in HMIM, CWGT.

**Etymology.** Dailam (persian دیلم) is the historical name of the mountain region on the south-west side of the Caspian Sea. Because of its mountain location Dailam was for a long time protected from the attacks of invading Arabs, its inhabitants much later being converted to Islam. The centre was the Assassin fortress of Alamut, a castle at 2100 m altitude that was regarded as impregnable, but was destroyed in 1275 by the Mongols.

**Figs 40–60.** ***Zygaena tamara.*** **40–42.** ***Z. tamara zuleiqa*** **Naumann & Naumann, 1980**. **40.** ♂, "Hakkāri | 1300–2100 m | (Hakkāri ) - Turquie | 11 aoūt 1992 | Bernard MOLLET". **41.** ♂, "Türkei, SE Hakkari, Čilo | Dağ, Dez-Tal, 1800– | 2500 m, 15. VII. 2002 | leg. ten Hagen". **42.** ♀, same data. **43–45.** ***Z. tamara mahabadica*** **Reiss, 1978**. **43, 44.** ♂, "IRAN, Kurdestan | Sanandaj NW, Saqqez - | Baneh (pass) 1950– 2100 m | 5.7.2005 [51/05] | A. Hofmann & B. Mollet leg.". **45.** ♀, same data. **46 –48.** ***Z. tamara fahima*** **Naumann & Naumann, 1980**. **46, 47.** ♂, "Iran | Prov. Esfahan, Ferey- | dun Shahr S, Sibak SE | Kuh-e Sibak, 2700–3000 | m, 13.6. 2010, [23/10] | leg. A. Hofmann". **48.** ♀, same data. **49–54.** ***Z. tamara kendevanica*** **Tremewan, 1977**. **49.** ♂, "IRAN | Zanjan- | Gilvan | 1, Paß ca. 1 km N | Garovol Dag | 2400–2500 m | 3.–4.7.1999 | A. Hofmann & J.U. Meineke leg.". **50, 51.** ♂, "IRAN F1, e.o. | Zanjan-Gilvan | Gargovol Dag, 1, Paß, ca. 1 km N | des Passes, 2400–2500 m e.p. : | 23.4.–3.5.2002 | A. Hofmann cult.". **52 – 57.** ♀, same data. **55–60.** ***Z. tamara dailamica*** **ssp. n.**. **55.** Holotype, ♂, "IRAN, Qazvin | Hir NE, Gardaneh-ye | Ambarkesh, N-Seite, 2780– | 2900 m, 13.7. 2006, [16/06] | A. Hofmann & A. Naderi leg.". **56.** Paratype, ♂, "IRAN, Mazandaran | Tonekabon SW, Tamol vic. | 2250–2400 m | 14.7. 2006 [28/06], A. Hofmann & A. Naderi leg.". **57.** Paratype, ♀, same data. **58.** Paratype, ♂, "IRAN e.o. | Prov. Qazvin Hir NE | Gardaneh-ye Ambarkesh | N-Seite, 2780–2900 m | [26/06], e.p. : 26.4. – 29.5.2007 | T. & A. Hofmann cult.". **59.** Paratype, ♀, "Iran, Prov. | Mazandaran Tone- | kabon SW, Tamol vic. | 2250–2400 m | 13.7. 2010 [37/10], leg. A. Hofmann ". **60.** Paratype, ♀, "IRAN e.o. | Prov. Mazandaran, | Tonekabon SW, Tamol vic. | 2300 m, [28/06] | e.p. : 15.–24.5.2008 | T. & A. Hofmann cult.".

**Figs 61–72.** ***Zygaena tamara and Z. tamara dailamica*** **ssp. n., habitats, bionomics**. **61.** Treeless, high-mountain steppe habitat above Tamol (13.vii. 2010), dominated by cushions, thorny and spiny vegetation and grasses. **62.** Copula of *Z. tamara dailamica* ssp. n. on *Acantholimon* cushion (Plumbaginaceae) (Gardaneh-ye Tondrokosh, 13.vii.2010); note the single red abdominal cingulum. **62.** *Zygaena tamara mahabadica*, e.o., e.p. 29.v.2009; note the red abdominal cingulum over three segments. **64–68.** Final instar larva (lateral, dorsal, ventral views) of *Z. tamara dailamica* ssp. n. (1.–12.V.2009, Gardaneh-ye Ambarkesh). **69.** Comparison of fully-grown larvae of *Z. tamara dailamica* ssp. n. (above) from type-locality and *Z. tamara mahabadica* (Iran, Kurdestan, Baneh vic.) (below). **70.** Cocoons with exuviae of *Z. tamara dailamica* ssp. n. **71.** Cocoons with exuviae of *Z. tamara mahabadica* (Iran, Kurdestan, Baneh vic.). **72.** Comparison of exuviae of *Z. tamara dailamica* ssp. n. (dark brown) from type-locality and *Z. tamara mahabadica* (Iran, Kurdestan, Baneh vic.) (light brown).

**Description.** Black ground colour with greenish or greyish sheen. Coloration of forewing spots warm red but without a tendency to orange. Hindwings less densely scaled, slightly translucent. Spots 1+2+2a forming a large basal blotch that is always well separated from the spot pair 3+4. Spot 3 smaller than spot 5, connected to the largest spot (spot 4). Spot 5 quadrangular, attached to spot 6, in the majority with a groove in the upper part, occasionally isolated, especially in the males. Spot 6 large, pear-shaped when separated from spot 5. Spot 6 completely absent in one female. Hindwings with a narrow greyish black border that can be broadened slightly at the apex. Red patagia and red abdominal belt always present on one segment, the latter closed ventrally. Tegulae consistently black in males, in females sometimes mixed with a few red scales. Legs greyish white in both sexes.

**Diagnosis.** Imago: From all other populations of *Z. tamara* the new subspecies is well separated by the one-segmented red cingulum on the abdomen (Fig. 62). Moreover, the red coloration is colder, less orange than in the red populations of *Z. tamara* (*Z. tamara placida*, *Z. tamara kendevanica*). The distance between the spot pairs 1+2+2a and 3+4 of these subspecies is broader than that in *Z. tamara dailamica* ssp. n., thus forming a broad black band of ground colour.

Preimaginal stages: Already the L1 larva is darker than larvae of *Z. tamara* from other localities. This is even more obvious in the diapausing stage. Post-diapause larvae and fully-grown larvae exhibit a more dirty-yellow ground colour with more brownish grey-yellow on the verrucae. While the fully-grown larvae of *Z. tamara* are nearly unicolorous without contrasting elements, those of *dailamica* ssp. n. are much more strongly marked with the anterior dorsal spots (ADS) well developed and the yellow dorso-subdorsal spots well visible and present on 10 segments (Figs 64–69). Moreover, constant differences exist in the sclerotization of the pupae and even in the coloration of the cocoon (Figs 70–72). The exuviae of *dailamica* ssp. n. are dark brown, in contrast to the light- to mid-brown coloration in all other known populations of *Z. tamara*. The coloration of the cocoon is consistently slightly darker, less yellowish but light white-brownish with a tinge of green. Cocoons of *Z. tamara* from Zanjan, Baneh (Kurdestan), Golujeh (Azerbaijan-e Sharqi) or from Dorud (Lorestan) are light yellow to white (Fig. 71).

**Bionomics.** All habitats of *Z. tamara dailamica* ssp. n. are treeless slopes with a combination of arboreal, oreal and eremic vegetation, e.g. *Securigera varia* (L.) Lassen (Fabaceae) is found in the immediate vicinity of *Onobrychis cornuta* (L.) Desv. (Fabaceae), *Eryngium billardieri* Delar. (Apiaceae), *Astragalus* (*Tragacanthus*) (Fabaceae) cushions and yellow-flowering *Phlomis* (Lamiaceae), typical for the narrow transitional zone between the humid Hyrcanian and the more arid eremic regions. At the first locality (Gardaneh Anbarkesh), Z. *tamara dailamica* ssp. n. is syntopic with *Z. cambysea* Lederer, 1870, while at the more northerly sites it is syntopic with *Z. haberhaueri* Lederer, 1870. In the more humid valley that lies between the two mountain ranges, where there is intensive agriculture, plenty of orchards and many villages, only *Z. loti* (Denis & Schiffermüller, 1775) and *Z. dorycnii* Ochsenheimer, 1808, were found; just 100–200 m higher up, the vegetation changes rapidly and becomes much drier and is partly grazed intensively by goats and sheep. These are the biotopes where, in the vicinity of Tamol, Z. *tamara dailamica* ssp. n. and *Z. haberhaueri* were accompanied by these two species, a faunistic combination that is atypical for *Z. tamara*. In its biotopes, *Z. tamara* is usually accompanied by species typical of the Zagros arid climate, e.g. *Z. turkmenica* Reiss, 1933, *Z. escalerai* Poujade, 1900, *Z. rosinae* Korb, 1903, Z. *cambysea*. The sympatry in the vicinity of Tamol represents a faunistic mixture comprising two species that are typical for the northern side of the Alborz Range (*Z. dorycnii*, *Z. loti*), while the latter species does not even cross the Alborz main chain to the south.

After 10.00 h, moths were observed nectaring at the pinkish flowers of *Salvia*, but preferred to sit on the flower heads of some Dipsacaceae, viz. a white and bluish *Scabiosa* sp. and a tall white-flowered *Cephalaria* sp. Several copulae were found sitting on dry stems or on the flowers of scabious during the afternoon after 15.00 h, rarely on cushions of an *Acanthophylum* sp.

**Distribution.** *Zygaena tamara dailamica* ssp. n. was found only at altitudes between 2250–3000 m. Its distribution is restricted to the central Alborz range between north of Qazvin and south of Tonekabon and extends over two north-westerly/south-easterly ranging mountain chains with a valley of 1700–1900 m in between. In its most northerly sites *Zygaena tamara dailamica* ssp. n. inhabits slopes that are open to the Caspian Sea.

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